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Memory facilitation as a function of category cues and stimulus list construction

Janet Sanford Graves

MEMORY FACILITATION AS A FUNCTION OF CATEGORY CUES AND STIMULUS LIST CONSTRUCTION

by

Janet Sanford Graves

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Janet Sanford Graves

Approved:

L. James Tromater, Ph.D.
Chairman

Austin E. Grigg, Ph.D.

William H. Leftwich, Ph.D.

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Chapter I

INTRODUCTION

The capacity to effectively reorganize material to be recalled is perhaps the most essential element in the complex retention process (Deese, 1958). A known type of reorganizational procedure which was shown to exist by Bousfield (1953) in his investigation of the retention of a randomized word list is the grouping or clustering of associated words. The results of his study clearly indicated that upon immediate recall of a randomized list, related items, that is, items belonging to the same category, are listed together in clusters.

Further investigation (Bousfield & Cohen, 1955) demonstrated that high frequency words which have a relatively high degree of habit strength are recalled more often than low frequency items. Stimulus words seem to be ranked according to degree of habit strength with high habit strength words being recalled before low habit strength items.

Bousfield & Cohen (1953, 1955) designated to-be-remembered (TBR) words as subordinate items. Presumedly, the subordinate item having the highest habit strength is recalled first. This word in turn elicits a superordinate structure, the category word. The elicitation of the category name is the important mediating process which brings to the surface, so to speak, the other subordinates of lesser habit strength

which are related to this particular superordinate structure or category word (Bousfield & Cohen, 1953, 1955).

Puff (1966) studied both the clustering phenomenon and recall as a function of list organization by varying the number of times a stimulus word was succeeded by a member of its category. As list organization increased, clustering and recall increased. These findings lend credence to those of other investigators, such as Dallett (1964) and Weingartner (1964), who obtained similar results.

Evidence for the importance of organization was presented by Miller (1956) in an informative paper dealing with the amount of information that can be accurately retrieved. Miller stated that in the area of immediate memory lists of TBR words are organized into a few broad "chunks" or categories under which several "bits" of information, i.e., words belonging to the category, are coded. A limit to the number of "chunks" that can be retained was suggested and cautiously placed at seven plus or minus two units. In recent years a more stringent limit of five plus or minus two has been imposed (Mandler, 1967). Miller maintained that the amount of information which can be processed with a degree of success is increased by increasing the number of "bits" of information per category.

According to Cohen (1966) the free recall of a categorized word list entails a three stage process of detection, storage, and retrieval. An awareness of the categorized structure of the list constitutes the initial stage. Items are then stored either independently or coded dependently into categories with the category names being stored and hopefully retrieved.

Cohen's (1966) investigation of the coding process set forth by Miller (1956) led to his formulation of the "some-or-none" characteristics of the retrieval phase of retention. These characteristics specify either total failure to recall words within a category or recall of a portion of the items in that category. The mean number of words recalled per category was found to be invariant with regard to such factors as rate of presentation, sex, category size, and list length. It is interesting to note that although sex differences did not play a part in the mean number of words recalled per category, female Ss recalled significantly more items and more categories than their male counterparts. Cohen pointed out that failure to recall words in a category does not necessarily imply failure to detect or store the category in memory.

Whether a failed item was unavailable in the memory store or merely inaccessible at the time of recall was the subject of an investigation by Tulving & Pearlstone (1966). Their design consisted of a 3 x 3 x 2 factorial in which a list of 12, 24, or 48 categorized words containing 1, 2, or 4 items per category (IPC) was presented on a single trial to Ss who recalled the items under a cued or noncued recall condition. Items were presented orally in block form with the category name given first followed by member words. Prior to list presentation Ss were informed of list length, number of categories within the list, and number of IPC. Category names served as cues for retrieval.

Cued recall was significantly greater than noncued recall in every case except that of the 12-item list having four IPC. This difference was not statistically significant. Cued recall was found to be an inverse function of the number of words per category and a positive function of list length. The number of categories represented in recall

was greater for the cued than the noncued condition, whereas the mean number of IPC recalled remained relatively constant. Tulving & Pearlstone (1966) suggested that these findings imply a dual component retrieval process in which one component is associated with the accessibility of higher-order memory units, such as category names. Suitable retrieval aids promote the accessibility of such units. The second, distinct component deals with the accessibility of words subordinate to the higher-order memory units. It was noted that the organization of TBR words into higher-order units either explicitly by the E or subjectively by the S serves to make items more accessible for recall. Tulving & Pearlstone concluded that many words which were not recalled in the noncued condition were available in the memory store but not accessible during the retrieval phase. The results of studies by Howe (1967) and Dong & Kintsch (1968) tend to support the above conclusion.

Dong & Kintsch (1968) required their Ss to subjectively sort unrelated words into categories with the stipulation that each group of words be sorted identically on two consecutive trials. After criterion was attained three groups of Ss were asked to give overt subjective labels to each category used, while a fourth group was not required to give this information. On a free recall test Ss given their own subjective category labels as relevant retrieval cues had significantly greater recall and recalled significantly more categories than did those in unaided and irrelevant cue conditions. There were no significant differences among the groups with respect to the mean number of items recalled per category. The authors pointed out that Ss in the relevant cue condition recalled more words as a result of the accessi-

bility of more category clusters and not as a result of increasing the number of words recalled per category. They further stated that relevant retrieval cues seem to make more TBR words accessible in the memory store.

Tulving & Osler (1968) have extended the investigation of the effect of prompters upon memory facilitation by further experimental manipulation of such cues. In their study lists of words were visually presented on a single trial in the presence or absence of one or two cues per item. Each cue had a weak associative connection to its respective TBR word. The presence or absence of cues constituted the various recall conditions of the retrieval phase. A statistically significant increase in recall was found when cues were given at both storage and retrieval. Presenting cues only at retrieval resulted in significantly lower recall than the absence of cues at both stages. Presenting one set of cues at storage and another equivalent set at retrieval resulted in lower recall than cues at storage and retrieval and cues presented only at storage. The recall of Ss having two simultaneously presented cues per word at input and output did not significantly differ from that of Ss presented with single cues at both stages.

The primary conclusion drawn from the findings was that the relationship between retrieval cues and TBR items must be established during the input stage for retrieval cues to facilitate recall (Tulving & Osler, 1968). The apparent discord between the above conclusion and the results of studies showing recall facilitation with retrieval cues presented only at output (Bahrick, 1969; Lloyd, 1964) was reconciled by Tulving & Osler (1968) who pointed out that Ss may employ their own subjective coding process at input. Recall is supposedly facilitated

by the extent to which retrieval cues given at output overlap with the particular subjective coding process used during storage (Tulving & Osler, 1968).

In the first of two experiments reported by Wood (1967), retrieval cues with relatively high taxonomic frequencies were employed. Category cues at storage and retrieval significantly facilitated the recall of an unrelated word list. Supplying category cues only at the retrieval stage also resulted in significantly greater recall than that of a non-cued condition. Wood concluded that retrieval cues are not required at input in order to facilitate recall. However, in the second portion of his study (Wood, 1967), category cues varying in taxonomic frequency were presented only at recall. Retrieval cues having high taxonomic frequencies resulted in significantly greater recall than cues with low taxonomic frequencies and noncued recall. Wood stated that the level of taxonomic frequency is apparently the important variable in determining the effectiveness of category cues in recall facilitation.

Crouse (1968), as Tulving & Osler (1968), used retrieval cues with low taxonomic frequencies and found recall facilitated when such cues were provided at storage and retrieval. Recall was not facilitated when these cues were presented only at output. Crouse (1968) pointed to the fact that the second portion of Wood's (1967) investigation demonstrated that the facilitatory effect of cues presented only at recall is eradicated when such cues have low taxonomic frequencies.

The findings of these and other investigators (Earhard, 1969; Tulving, 1966; Wood, 1969a) are indicative of a dependent storage model. According to this model TBR items are organized and stored in a subordinate manner by a variety of mnemonic devices (Cohen, 1966; Slamecka,

1968). As previously mentioned, stimulus words are thought to be stored dependently or independently as separate units (Cohen, 1966). The question of an independent vs. a dependent storage system served as the topic for a series of studies by Slamecka (1968, 1969). Slamecka stated that dependent storage denotes interitem associations such that the state of one item affects that of another, whereas independent storage refers to isolated units having no such interitem connections. If stimulus words are stored according to a dependent model, Slamecka maintained that providing some of these items or context words at retrieval should facilitate recall of the remaining stimulus words or critical items. On the other hand, if items are stored independently, presenting context words at retrieval should not influence the recall of critical words. With variations in list construction, number of context cues, and number of trials, the basic design for Slamecka's (1968, 1969) experiments centered around a comparison of critical word recall for a context group provided with context items at retrieval and a control group receiving no context cues at recall. Of particular import is Exp. IV (Slamecka, 1968) in which categorized lists were used. Each list was composed of six words from each of five categories. After oral presentation of a randomized list, Ss received 0, 1, 3, or 5 context words per category. Analysis of critical word recall data showed that the context conditions were significantly inferior to the control condition. In fact, in the majority of studies (Slamecka, 1968, 1969) context groups exhibited significantly inferior recall. At no time did context words facilitate the retrieval of critical items. Slamecka (1968, 1969) concluded that his findings support an independent storage model.

The above conclusion (Slamecka, 1968, 1969) served as the impetus for two experiments reported by Hudson & Austin (1970). According to these investigators potential aids for recall facilitation, context words in particular, must meet two requirements in order to be successful. The first of these conditions states that context cues must be or mediate retrieval cues for higher-order memory units. Secondly, context cues must elicit more higher-order units than unaided recall. These requirements were not thought to be met in Slamecka's (1968, 1969) studies (Hudson & Austin, 1970). Citing Exp. IV (Slamecka, 1968) as a primary example, Hudson & Austin (1970) pointed to the fact that most of the control group recalled at least one word from each of the five taxonomic categories used. Context cues did not, therefore, elicit more higher-order units, i.e., categories, than the control condition.

Hudson & Austin (1970) based their work on the premise that context cues would have facilitated recall if the above conditions were met. A 30 word list composed of three items from each of 10 categories was used in their first study. All Ss were informed of list construction and were given the category names prior to the first of five acquisition-recall trials. Critical word recall for both a context condition and a category group given the category names as retrieval cues was significantly greater than an unaided control group. Both the category and context condition recalled more higher-order units than the control condition.

Except for the use of stimulus items with weak category connections, a slower presentation rate, and an additional acquisition-recall trial, the procedure for the second experiment was the same. Analysis of the data showed significantly greater recall for the category condition than

for either the control or context group. Lack of recall facilitation for the context condition was attributed to the fact that context cues did not elicit more higher-order memory units than the unaided control condition. The results of both studies were interpreted as support for a dependent storage model (Hudson & Austin, 1970).

The effect of context cues on memory facilitation was also investigated by Wood (1969b) and Lewis (1971). Wood (1969b) found that context cues given at the end of a series of study-test trials enhanced the recall of a categorized word list when related items were presented in block form. Such cues failed to facilitate recall when items within the stimulus list were randomly presented. Wood intimated that the effect of context cues used as retrieval aids after block presentation trials to increase the accessibility of available higher-order memory units may be restricted to cases in which lists are composed of several small units, as with the list of 18 three-word categories used in his study. Wood's (1969b) results, however, were replicated by Lewis (1971) who used five lists each consisting of six, seven-item categories.

The most pertinent and perhaps the best explanation as to why context cues in the two studies reported above enhanced the recall of related items presented in block but not random form was given by Lewis (1971). The organization of list items in the memory store was seen as the key to context cue facilitation (Lewis, 1971). With block presentation related items hold consecutive positions in the stimulus list thus increasing the probability that Ss form subjective higher-order memory units closely resembling, if not identical to, those category units employed by E to construct the list. If retrieval cues given at output aid recall only to the extent that they overlap with the particular

subjective coding process used during storage (Tulving & Osler, 1968), then context cues in this instance should have a facilitatory effect (Lewis, 1971). On the other hand, when related words are randomly presented, the organizational process used by Ss is less likely to coincide with that of the E. In such a case context items may prove to be inappropriate retrieval cues and may even have a derogatory effect (Lewis, 1971).

It should be noted that in Hudson & Austin's (1970) studies related stimulus items were randomly distributed throughout the acquisition list, and yet evidence was found that context cues enhanced recall. Hudson & Austin asserted that the function of a context item given as an aid at recall is to re-establish the category name under which other subordinate items were stored. Although items were presented randomly, the category names were given to all Ss prior to the first acquisition trial. The organizational structure of the list was thus established and perhaps allowed context words presented at recall to mediate the category names more readily.

The present investigation was designed to study memory facilitation as a function of category cues and stimulus list construction. Attention was focused upon the recall of stimulus lists whose members could be regrouped and equally divided into various, distinct categories. The weight of the evidence (Crouse, 1968; Tulving & Osler, 1968; Wood, 1967) seems to indicate that providing relevant retrieval cues only at storage does not appreciably affect the immediate recall of list items. In fact, the effect of providing such cues with relatively high taxonomic frequencies at storage and/or recall should be negligible if the number of categories employed to construct the acquisition list is well within the

range of immediate memory. On the other hand, presenting such cues at storage and/or retrieval should facilitate recall if the number of categories used in list construction exceeds the number that can be held in the immediate memory store. These predictions are also advocated in part by Mandler (1967).

Chapter II

METHOD

Subjects. Two hundred and sixty-two male and female undergraduate students from introductory psychology courses at the University of Richmond served as Ss. In order to eliminate possible confounding effects due to sex differences (Cohen, 1966), only data for the 155 male Ss were used.

Apparatus. Two 30-word lists, 262 test booklets, and a Craig "212 Cassette" Tape Recorder (Model 2603) were the materials used in this investigation. Words for the first or accessible category list (ACL) were chosen by randomly selecting five categories from the category norms of Battig & Montague (1969). These categories plus an additional five categories from the same source provided the framework for the second or inaccessible category list (ICL). To eliminate confusion in both lists, an attempt was made to omit so called "sound alike" words, e.g., potato and tomato, as well as items that could be placed in more than one category.

From each of the five categories in the ACL, the first six words representing the items with the highest frequency of occurrence measures in the norms were chosen. Where a word might have caused confusion as noted above, it was replaced by a seventh or eighth ranked item. The list of words was constructed by randomly selecting five words from the pool of 30 items so that each of the categories was represented. E then

started with the category denoted by the second word selecting an item from that category and the categories represented by the third, fourth, fifth, and first item. This rotation process was continued until the list was completed. The categories and stimulus list are shown in Table 1.

For the ICL three words were chosen from the first six to eight items in each of the 10 categories. ICL construction followed the same rotation procedure as stated above. The categories and stimulus words for this list are shown in Table 2.

The test booklets consisted of a cover page stapled to a test page. On the reverse side of the test page, 70 booklets designed for the ACL had the following directions for the hint condition, test phase (HT): "The 30 words can be equally divided into 5 categories of 6 words each. The 5 categories are: Trees, Vegetables, Insects, Colors, and Flowers. Write down as many of the 30 words as you can remember." An additional 76 booklets designed for the ICL, HT were essentially the same except that the first line of the instructions stated that: "The 30 words can be equally divided into 10 categories of 3 words each." Appropriate category names were then given. The remaining 116 booklets had the following no hint, test phase (NHT) directions on the back side of the test page: "Write down as many of the 30 words as you can remember."

Procedure. A 2 x 2 x 2 factorial design was used in which a hint group (H) was given information concerning the division of list words into categories plus the category names prior to the reading of a stimulus list and a no hint group (NH) which was not given this information. Ss were required to listen to the reading of a list of 30 words and then to recall as many of the words as possible under one of two test phase

Table 1

Accessible Category List

Category Names: Trees, Vegetables, Insects, Colors, and Flowers

Word List

1.	Rose	16.	Dogwood
2.	Spider	17.	Orange
3.	Corn	18.	Carnation
4.	Pine	19.	Beetle
5.	Blue	20.	Lettuce
6.	Ant	21.	Black
7.	Pea	22.	Orchid
8.	Birch	23.	Fly
9.	Yellow	24.	Tomato
10.	Tulip	25.	Elm
11.	Carrot	26.	Lily
12.	Oak	27.	Mosquito
13.	Green	28.	Bean
14.	Daisy	29.	Maple
15.	Bee	30.	Red

Table 2

Inaccessible Category List

Category Names: Trees, Vegetables, Insects, Colors, Flowers, Metals, Vehicles, Sports, Animals, and Relatives

Word List

1.	Tomato	16.	Maple
2.	Bee	17.	Cow
3.	Green	18.	Tin
4.	Tulip	19.	Car
5.	Brother	20.	Pea
6.	Swimming	21.	Yellow
7.	Birch	22.	Lily
8.	Horse	23.	Father
9.	Iron	24.	Tennis
10.	Airplane	25.	Pine
11.	Spider	26.	Cat
12.	Blue	27.	Steel
13.	Daisy	28.	Train
14.	Sister	29.	Bean
15.	Football	30.	Fly

conditions, HT and NHT, as mentioned above. The ACL and ICL constituted the levels of the third or list factor.

Pre-test phase instructions and the acquisition lists were presented by means of a tape recorder with stimulus items being recorded at a 2-sec. rate. Nine class groups ranging from 13 to 42 Ss were run under one of the following conditions: H, ACL; H, ICL; NH, ACL; and NH, ICL. Instructions for these groups appear in Appendix A. Within each group a portion of the Ss served under the HT condition, while the remaining Ss served under the NHT condition. Immediately after stimulus list presentation, Ss were given the following directions: "That completes the list. When I give you the signal, turn the test booklet over to the back of the last page and read the instructions at the top. Write down the words in any order. You will have five min. Ready . . . Go!"

At the end of five min. Ss were told to "Stop." The booklets were collected, and answers were scored. The number of correct responses, the number of categories recalled as defined by Cohen (1966), the proportion of categories recalled, the mean number of IPC, and the proportion of the mean number of IPC were recorded on a data sheet. In order to obtain equal cell frequencies, the number of male Ss was reduced to 15 Ss per condition by the use of a table of random numbers (Downie & Heath, 1965).

Chapter III

RESULTS

Analysis of frequency of occurrence measures for ACL and ICL items resulted in no significant difference between the lists, $t = 1.21$, $df = 58$, $p > .05$.

Mean number of correct responses for the various cued and uncued treatment combinations are presented in Fig. 1 as a function of stimulus list construction. An analysis of variance for the total number of correct responses (Appendix B, Table I) yielded a significant difference between H and NH during the training phase, F (1, 112) = 4.26, $p < .05$. The mean for H and NH was 18.12 and 16.53 respectively. A significant difference was also found between HT and NHT, F (1, 112) = 17.20, $p < .001$. The mean number of correct responses for HT and NHT was 18.92 and 15.73 respectively. No significant difference was obtained for the main effects of the list factor or for any of the interaction effects ($p > .05$).

The following six analysis of variance are based on a division of the three factor design into a 2 x 2 factorial for ACL and ICL in which factor A is composed of the levels of the training phase, i.e., H and NH, and factor B the levels of the test phase, i.e., HT and NHT. Further analysis of the total number of correct responses within this framework for ACL (Appendix B, Table II) showed a significant difference between HT and NHT, F (1, 56) = 10.77, $p < .01$. The mean for HT was 18.73, while that for NHT was 15.67. No other significant differences were

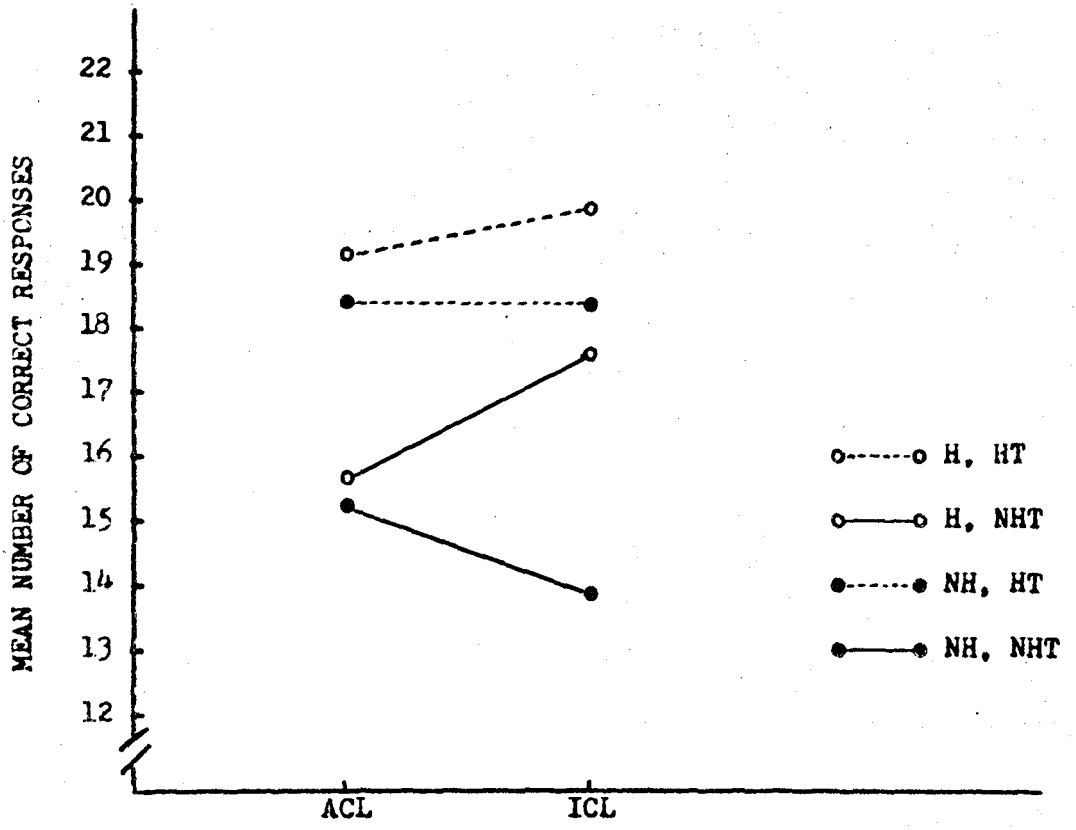

Fig. 1. Mean number of correct responses for the cued and uncued treatment combinations as a function of stimulus list construction.

obtained ($p > .05$). Analysis of the total number of correct responses for ICL (Appendix B, Table III) yielded a significant difference between H and NH, F (1, 56) = 4.68, $p < .05$. The mean for H and NH was 18.77 and 16.13 respectively. A significant difference was also found for the main effects of factor B, F (1, 56) = 7.35, $p < .01$. The mean number of correct responses for HT and NHT was 19.10 and 15.80 respectively. No other significant differences were obtained ($p > .05$).

An analysis of variance for the number of categories recalled within ACL (Appendix B, Table IV) resulted in a significant difference between HT and NHT, F (1, 56) = 10.90, $p < .01$. The mean for HT and NHT was 5.00 and 4.67 respectively. No other significant differences were found ($p > .05$). The analysis for the number of categories recalled within ICL (Appendix B, Table V) yielded a significant difference for the main effects of factor A, F (1, 56) = 8.18, $p < .01$ and for the main effects of factor B, F (1, 56) = 35.50, $p < .001$. A significant interaction effect was also obtained, F (1, 56) = 4.60, $p < .05$. Mean number of categories recalled for the training phase at the levels of the test phase are presented in Fig. 2. Analysis of simple effects showed a significant difference between H and NH at NHT, F (1, 56) = 12.52, $p < .01$. The number of categories recalled under H was significantly greater than under NH for the NHT condition. No other significant differences were found ($p > .05$).

An analysis of the mean number of IPC for ACL (Appendix B, Table VI) showed no significant differences ($p > .05$). The results of a similar analysis for the mean number of IPC for ICL (Appendix B, Table VII) also revealed no significant differences ($p > .05$).

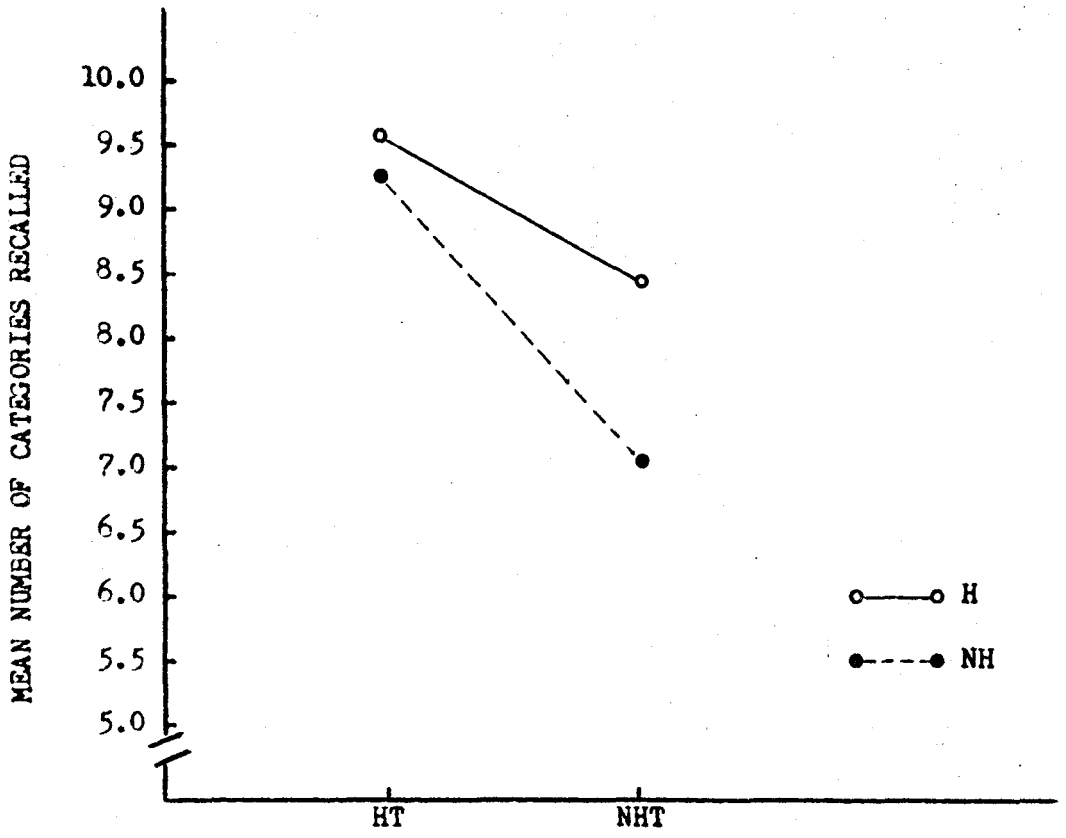

Fig. 2. Mean number of categories recalled for the training phase as a function of the test phase.

Analysis of an arcsin transformation (Winer, 1962, p. 221) on the proportion of categories recalled for the 2 x 2 x 2 factorial (Appendix B, Table VIII) yielded a significant difference between H and NH, F (1, 112) = 5.62 $p < .05$. The mean for H and NH was 2.80 and 2.65 respectively. Significant differences were found for main effects of factor B, F (1, 112) = 48.25, $p < .001$ and factor C, i.e., the list factor, F (1, 112) = 48.70, $p < .001$. A significant BC interaction was also obtained, F (1, 112) = 6.29, $p < .05$. Mean transformed proportions of the number of categories recalled for the lists at the levels of the test phase are presented in Fig. 3. Analysis of simple effects showed a significant difference between the lists for HT, F (1, 112) = 10.00, $p < .01$ and for NHT, F (1, 112) = 44.99, $p < .001$. The transformed proportions of categories recalled for ACL were significantly greater than for ICL at both levels of the test phase condition.

The computed analysis of variance for an arcsin transformation on the proportion of the mean number of IPC (Appendix B, Table IX) revealed a significant difference between ACL and ICL, F (1, 112) = 10.90, $p < .01$. The mean for ACL and ICL was 1.76 and 1.94 respectively. No other significant differences were found ($p > .05$).

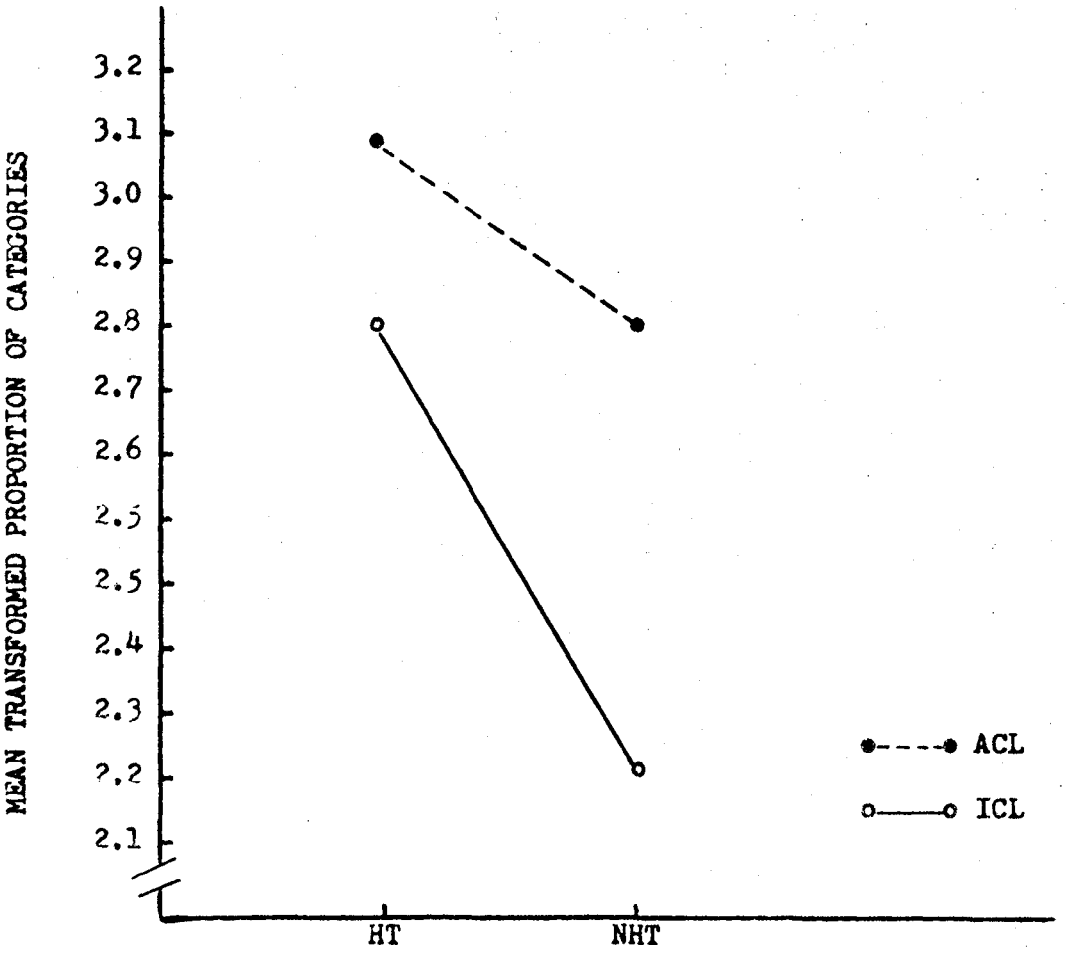

Fig. 3. Mean transformed proportions of the number of categories recalled for the lists as a function of the test phase.

Chapter IV

DISCUSSION

The results obtained for the overall analysis on the total number of correct responses seems to indicate that memory is facilitated by the introduction of category cues at either the storage or retrieval stage. Furthermore, these facilitatory effects appear to traverse the limits of stimulus list construction used in the present investigation.

Closer examination of this data based on a priori evidence revealed, however, that with ACL construction category cues aided recall only at the test phase. This analysis, contrary to the above findings, refuted only a portion of the hypothesis pertaining to the structural composition of ACL. As previously mentioned, the hypothesis states that appropriate cues given at storage and/or recall have a negligible effect if the number of categories used in forming the acquisition list is within the range of immediate memory. In the case of ICL construction category cues were found to have a facilitatory effect at both storage and retrieval. The hypothesis that such cues significantly enhance recall at storage and/or retrieval providing the number of categories used in list construction exceeds the number that can be held in the immediate memory store seems to be tenable.

In order to achieve a better understanding of cuing effects obtained in the present study and their relationship to other pertinent variables, it is first necessary to look at category and IPC recall.

Findings related to category recall for ACL showed significantly more category representation with the presentation of cues at the test phase. There were indications that both cuing conditions had a favorable effect on category recall for ICL. In particular, significantly more categories were represented at NHT when cues were given at storage. However, the mean number of IPC within each list did not significantly differ for the various experimental conditions. These findings taken in concert clearly show that when stimulus lists composed of related items are used, recall of higher-order memory units, i.e., category names, is a critical factor in immediate memory facilitation. It is also evident that appropriate cues often make more TBR words accessible for retrieval. Realizing that it is hazardous to relate investigations with different procedures, the studies of Dong & Kintsch (1968), Hudson & Austin (1970), Tulving & Osler (1968), and Tulving & Pearlstone (1966) nevertheless lend credence to the above statements. The data support the dual component retrieval process proposed by Tulving & Pearlstone (1966) and add reinforcement to the proponents of a dependent storage model.

A plausible explanation for the partial rejection of the hypothesis dealing with ACL construction may be related to list difficulty. Some of the elements that determine list difficulty are represented by degrees of length, taxonomic frequency, and list structure. In the present investigation both list length and taxonomic frequency were held constant. Tulving & Pearlstone (1966) found cued recall to be a positive function of list length. Suppose for a moment that Ss can recall about seven categories when presented with a randomized list of related items (Miller, 1956). This supposition is supported in the present study for ICL, NH-NHT where the mean number of categories recalled was 7.07.

Although Ss may be limited to the recall of about seven categories in immediate memory, it is suggested that there is a basic stabilized structure below that limit in which the presentation of appropriate cues does not elicit significantly more TBR words. Categories together with IPC are the components of this proposed structure. It is suggested that the optimum stabilized structure is within the range proposed by Mandler (1967) and consists of five categories having five IPC. With the number of categories held constant, increases in list length by increases in the number of IPC could cause weak structural development. It is hypothesized that the facilitatory effect of cues presented at the test phase for ACL was a function of list length which interfered with the proposed structural development. Category cues at the test phase allowed for the elicitation of significantly more higher-order memory units because of weak structural development. A study extending the present design by using four acquisition lists composed of two 20-word lists--one consisting of five, four-item categories, the other having ten, two-item categories--and two 30-word lists with ACL and ICL construction may give support to the above hypothesis. It should be noted that this hypothesis is consistant with, and indeed parallels, Mandler's (1967) proposed hierarchical system for long term memory which will not be discussed here.

In general the findings revealed in this investigation support the position held by Tulving & Osler (1968) that recall is enhanced by the extent of overlap between cues presented solely at the test phase and the particular subjective coding process used at storage. They also support a conclusion essentially advocated by both Crouse (1968) and Wood (1967). In essence, this conclusion states that with high taxo-

nomic frequencies a facilitatory effect can be achieved with cues given only at the test phase.

Although Wood (1967) has singled out the level of taxonomic frequency as a determinant in category cue effectiveness, there are indications that stimulus list construction may also be an important variable. In the present study and in Wood's investigation the level of taxonomic frequency between category cues and TBR words was high. As previously noted, cues given at storage with ACL did not significantly effect recall. On the other hand, such cues did have a facilitatory effect with ICL. The stimulus list used by Wood was composed of 40 items from 40 different categories. Each item had its own category name as a cue. A reliable effect was not obtained when cues were presented only at storage. These findings suggest the possibility of differential effects with the presentation of storage cues along a continuum of stimulus list construction. Holding list length and taxonomic frequency constant, the proposed continuum represents degrees of list difficulty defined in terms of internal list structure. The gamut ranges from assured detection of stimulus list construction, i.e., block presentation of a related word list, to easy detection denoted by ACL, to moderately difficult detection designated by ICL, to difficult construction, i.e., an unrelated word list. Ss presented with category names at the training phase as cues for the retrieval of an unrelated word list may not be able to learn the cues sufficiently to produce a facilitatory effect. It is quite possible that the processes employed in the recall of TBR items varies with the construction of the acquisition list as defined in the above terms. An extended study of stimulus list construction along these theoretical lines may be advantageous.

An explanation for the lack of a significant difference between ACL and ICL is reflected in the results obtained for the arcsin transformation on both the proportion of categories recalled and the proportion of the mean number of IPC. Analysis of the transformed data showed that the proportion of categories recalled was significantly greater for ACL than ICL at both HT and NHT. The proportion of the mean number of IPC was greater for ICL than ACL. It seems that as the proportion of categories increases for ACL, the proportion of the mean number of IPC decreases. Conversely, as the proportion of categories decreases for ICL, there is a corresponding increase in the proportion of the mean number of IPC. Tulving & Pearlstone (1966) found similar results but suggested that the two elements may increase and decrease at different rates. These proportional fluctuations seem to be another topic for consideration.

The study of several other variables may serve to foster a better understanding of cuing effects in relation to immediate memory facilitation. Providing a variety of time intervals, e.g., two days, four days, and two weeks, between the training and test phase may add to the information. Allowing Ss to learn retrieval cues or a particular reorganizational schema prior to the training phase may also be advantageous.

Regardless of these or other previously mentioned factors, any additional research in the area of verbal learning must seriously consider the possibility of confounding effects due to sex differences. If females recall both significantly more higher-order memory units and TBR items (Cohen, 1966), then the probability of existing confounding effects due to sex differences in studies using combinations of male and female Ss gains strength. This is particularly true if the recall of higher-

order memory units is a crucial factor in immediate memory facilitation as it was shown to be in the present study and in those of other investigators (Dong & Kintsch, 1968; Hudson & Austin, 1970; Tulving & Osler, 1968; Tulving & Pearlstone, 1966).

A better understanding of cuing effects and stimulus list construction in relation to memory facilitation may contribute to the development of more efficient study methods. Perhaps of greater importance is the potential for such understanding to aid in the search for more effective ways to process, transmitt, and assimilate the gross influx of information that is so characteristic of our time. Further investigation is more than indicated and may prove to be both fruitful and necessary.

Chapter V

SUMMARY

A 2 x 2 x 2 factorial design was used to investigate the effect of category cues and stimulus list construction on memory facilitation. Specifically, it was hypothesized that the effect of presenting category names with high taxonomic frequencies at storage and/or recall is negligible providing the number of categories used to construct the acquisition list is within the range of immediate memory. On the other hand, it was proposed that such cues facilitate recall if the number of categories used in list construction exceeds this range.

Groups totaling 155 male Ss were read one of two lists under a hint condition (H) which was given information concerning the categorized structure of the list plus the category names or a no hint (NH) condition which was not given this information. During recall the H and NH groups were divided into a hint, test phase condition (HT) which was given category cues and a no hint, test phase condition (NHT) which was not cued. One of the two acquisition lists had five, six-item categories representing the accessible category list (ACL). The second consisted of ten, three-item categories representing the inaccessible category list (ICL).

Analysis of the data showed that category cues significantly facilitated recall at either the storage or retrieval stage regardless of stimulus list construction. However, further analysis revealed that

category cues significantly enhanced recall only at the test phase for the ACL condition. These findings partially refute the first hypothesis and tend to support the second.

It should also be noted that significantly more higher-order memory units, i.e., categories, were represented where category cues were shown to be reliably effective. The mean number of items per category (IPC) did not significantly differ within each list. These results support those of other investigators (Dong & Kintsch, 1968; Hudson & Austin, 1970; Tulving & Osler, 1968; Tulving & Pearlstone, 1966) in showing that retrieval of higher-order memory units is a critical factor in the immediate recall of a categorized word list. Possibilities for further research in this area were discussed with respect to such factors as internal list structure, sex differences, and list length.

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APPENDIX A

Instructions

Instructions

Hint Group, Accessible Category List: "You will be read a list of 30 words which you will be asked to recall. The order in which the words are presented is not important. However, the 30 words can be equally divided into five categories of six words each. For example, scattered throughout the list you may find the words knife, gun, rifle, bomb, club, and sword. These six words belong to the category weapons. Try to remember as many of the words as possible. Before reading the list I will give you the five categories once and only once as possible aids for recall. When I have finished reading the list, I will ask you to write your answers on the back of the last page of the test booklet. Do not turn to the back page until I tell you to do so. Are there any questions? Here are the categories: Trees, Vegetables, Insects, Colors, and Flowers. Now here is the list. Listen carefully."

Hint Group, Inaccessible Category List: "You will be read a list of 30 words which you will be asked to recall. The order in which the words are presented is not important. However, the 30 words can be equally divided into 10 categories of three words each. For example, scattered throughout the list you may find the words knife, gun, and rifle. These three words belong to the category weapons. Try to remember as many of the words as possible. Before reading the list I will give you the 10 categories once and only once as possible aids for recall. When I have finished reading the list, I will ask you to write your answers on the back of the last page of the test booklet. Do not turn to the back page until I tell you to do so. Are there any questions? Here are the categories: Trees, Vegetables, Insects, Colors, Flowers, Metals, Vehicles, Sports, Animals, and Relatives. Now here is

the list. Listen carefully."

No Hint Group, Accessible Category List; No Hint Group, Inaccessible Category List: "You will be read a list of 30 words which you will be asked to recall. The order in which the words are presented is not important. Try to remember as many of the words as possible. When I have finished reading the list, I will ask you to write your answers on the back of the last page of the test booklet. Do not turn to the back page until I tell you to do so. Are there any questions? Here is the list. Listen carefully."

APPENDIX B

Summary Tables of Analysis of Variance

Table I

Summary of Analysis of Variance for the Total Number of Correct Responses

Source of Variation	df	MS	F
A (training phase)	1	75.208	4.256*
B (test phase)	1	304.008	17.203**
AB	1	3.675	0.208
C (lists)	1	1.875	0.106
AC	1	33.075	1.872
BC	1	0.409	0.023
ABC	1	16.875	0.955
Within cell	112	17.672	
Total	119		

* Significant at .05 level.

** Significant at .001 level.

Table II

Summary of Analysis of Variance on the Total Number of Correct Responses for ACL

Source of Variation	df	MS	F
A (training phase)	1	4.270	0.326
B (test phase)	1	141.070	10.765*
AB	1	2.390	0.182
Within cell	56	13.105	
Total	59		

* Significant at .01 level.

Table III

Summary of Analysis of Variance on the Total Number of Correct Responses for ICL

Source of Variation	df	MS	F
A (training phase)	1	104.020	4.678*
B (test phase)	1	163.350	7.346**
AB	1	18.150	0.816
Within cell	56	22.238	
Total	59		

* Significant at .05 level.

** Significant at .01 level.

Table IV

Summary of Analysis of Variance on the Number of Categories Recalled for ACL

Source of Variation	df	MS	F
A (training phase)	1	0.060	0.394
B (test phase)	1	1.660	10.900*
AB	1	0.080	0.525
Within cell	56	0.152	
Total	59		

* Significant at .01 level.

Table V

Summary of Analysis of Variance on the Number of Categories Recalled for ICL

Source of Variation	df	MS	F
A (training phase)	1	9.600	8.179**
B (test phase)	1	41.670	35.502***
AB	1	5.400	4.601*
Within cell	56	1.174	
Total	59		

* Significant at .05 level.

** Significant at .01 level.

*** Significant at .001 level.

Table VI

Summary of Analysis of Variance on the

Mean Number of IPC for ACL

Source of Variation	df	MS	F
A (training phase)	1	0.011	0.019
B (test phase)	1	2.128	3.861
AB	1	0.384	0.697
Within cell	56	0.551	
Total	59		

Table VII

Summary of Analysis of Variance on the

Mean Number of IPC for ICL

Source of Variation	df	MS	F
A (training phase)	1	0.208	1.288
B (test phase)	1	0.001	0.008
AB	1	0.000	0.000
Within cell	56	0.161	
Total	59		

Table VIII

Summary of Analysis of Variance for an Arcsin Transformation on the Proportion of Categories Recalled

Source of Variation	df	MS	F
A (training phase)	1	0.642	5.618*
B (test phase)	1	5.513	48.248**
AB	1	0.289	2.529
C (lists)	1	5.564	48.697**
AC	1	0.317	2.771
BC	1	0.718	6.287*
ABC	1	0.089	0.782
Within cell	112	0.114	
Total	119		

* Significant at .05 level.

** Significant at .001 level.

Table IX

Summary of Analysis of Variance for an Arcsin Transformation on the Proportion of the Mean Number of IPC

Source of Variation	df	MS	F
A (training phase)	1	0.101	1.189
B (test phase)	1	0.094	1.112
AB	1	0.024	0.280
C (lists)	1	0.924	10.902*
AC	1	0.084	0.995
BC	1	0.153	1.808
ABC	1	0.030	0.353
Within cell	112	0.085	
Total	119		

* Significant at .01 level.

VITA

Janet Sanford Graves, born on April 29, 1944, in Cleveland, Ohio, successfully completed her secondary education at The Collegiate Schools in Richmond, Virginia. After graduating from Collegiate in 1962, she attended Pine Manor Junior College in Wellesley, Massachusetts where she was awarded the degree of Associate in Arts in 1964. In the fall of that year she enrolled in the one-year secretarial program at Katharine Gibbs School in Boston, Massachusetts. Upon obtaining her certificate from Katharine Gibbs in 1965, she entered Westhampton College, a division of the University of Richmond, majoring in psychology. She was awarded the degree of Bachelor of Arts in June, 1967. In September, 1967, she began work toward the degree of Master of Arts in psychology at the University of Richmond where she was initiated into Psi Chi in 1968. She expects to be awarded the Master of Arts degree in August, 1972.